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PRIMER AND AUXILIARY FUEL DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed Jan. 21, 1918

Fig. 1

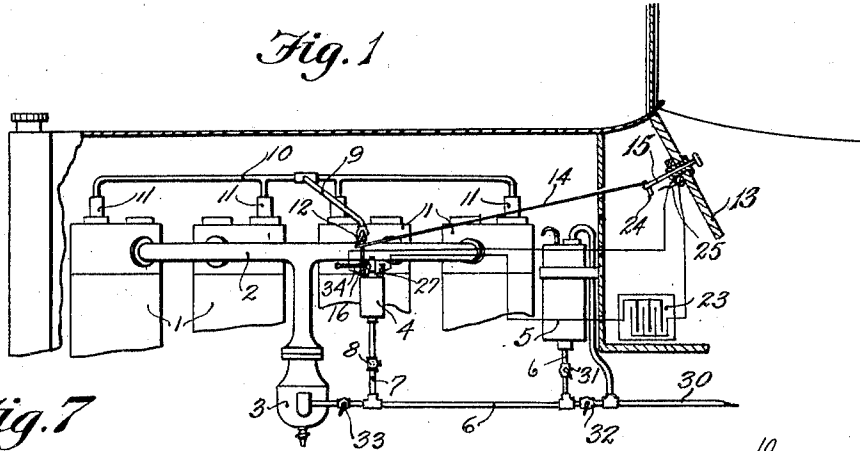


Fig. 7



Fig. 2

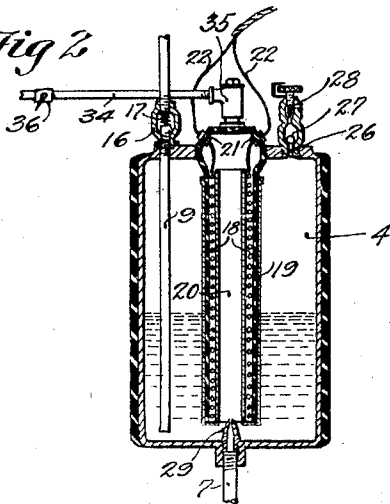


Fig. 3

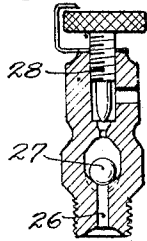


Fig. 4

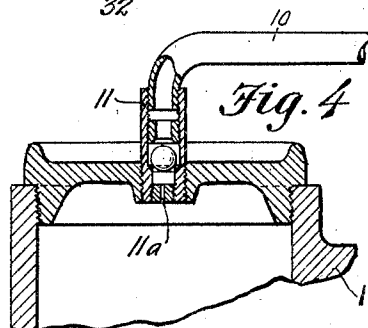


Fig. 5

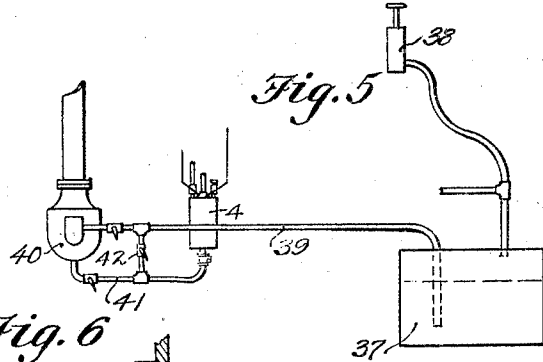
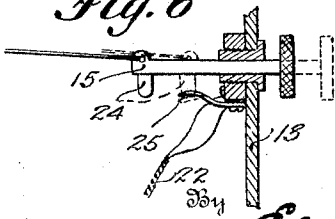


Fig. 6



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UNITED STATES PATENT OFFICE.

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PRIMER AND AUXILIARY FUEL DEVICE FOR INTERNAL-COMBUSTION ENGINES.

Application filed January 21, 1918. Serial No. 212,857.

To all whom it may concern:

Be it known that I, MELROSE G. KOPF, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Primers and Auxiliary Fuel Devices for Internal-Combustion Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to a primer and auxiliary fuel device for an internal combustion engine.

The object of the invention is, first, to provide a device for injecting a charge of fuel into the cylinder of the engine, when the latter is idle, to facilitate the starting of the same; and, second, to provide a device for feeding to the cylinder of the engine, when the latter is in operation, a heated, vaporized mixture of fuel and air to supplement the charge drawn from the carbureter.

It is also an object of the invention to provide means for delivering to the engine a measured initial charge; and for injecting the same into the cylinder of the engine under pressure; and for atomizing the same.

It is also an object of the invention to provide a device of this kind which will be very simple in its construction and operation and will comprise very few moving parts; and, further, to provide such a device with a very simple control operable from the instrument board of an automobile.

In the accompanying drawings Figure 1 is a longitudinal sectional view of a portion of an automobile showing the invention in elevation; Figure 2 is a vertical sectional view of the receptacle; Figure 3 is a detail view of the air valve for the receptacle; Figure 4 is a sectional view through the valve cap of one of the engine cylinders; Figure 5 is a diagrammatic view showing the invention applied to a pressure feed system; Figure 6 is a detail view of the actuating device; and Figure 7 is a perspective detail view of the feed nozzle leading to the cylinder.

In that embodiment of the invention here illustrated I have shown the same as applied to a four cylinder automobile

engine, but it will be obvious that the invention is equally applicable to engines of various kinds, and that the number of cylinders is immaterial. As here illustrated the cylinders of the engine are indicated by the reference numeral 1 and each cylinder is connected with the usual intake manifold, 2, which leads from the carbureter 3, which in turn may be of any suitable character and in itself forms no part of the invention. Connected with each cylinder of the engine is an auxiliary fuel feed device which operates, first, as a primer to facilitate the starting of the engine, and, second, as an auxiliary feed device to furnish an additional supply of fuel to the engine when the latter is in operation. To accomplish this latter function the device is in the nature of a mixing chamber in which vaporized fuel and air are mixed and are then drawn to the engine by the suction in the engine cylinder. In that form of the invention here shown the auxiliary feed device comprises a fuel receptacle, 4, connected with a source of fuel supply, which may be either the normal fuel supply for the engine, or a special fuel supply separately connected with the receptacle, such as a tank of ether or the like. Preferably, however, the receptacle is connected with a normal fuel supply, as here shown. It is desirable that means be provided for controlling the quantity of fuel in the receptacle 4 and for maintaining the same at a constant level when the engine is idle, thereby enabling a measured quantity, or charge, of fuel to be delivered to each cylinder of the engine when the contents of the receptacle are discharged therefrom. A predetermined quantity of fuel may be retained in the receptacle in various ways, but I prefer to accomplish this automatically by so positioning this receptacle with relation to some part of the fuel supply mechanism that the desired level of fuel will be maintained therein. In the present construction I have shown the engine as provided with a vacuum fuel feed device of a well known character, which comprises a fuel tank 5 connected with a source of fuel supply and with the carbureter 3, and within which the fuel is maintained at a constant level. As this vacuum feed is a standard commercial article it is not necessary to here describe its construction or operation in detail. The

vacuum feed tank 5 is connected with the carbureter by means of a pipe 6 and I have shown the receptacle 4 as connected with the pipe 6 between the tank and the carbureter, so that the fuel in the receptacle 4 will be maintained at the same level as the fuel in the tank 5. By a proper arrangement of the receptacle 4 with relation to the tank 5 the desired quantity of fuel can thus be maintained in the receptacle at all times when the engine is idle. As here shown the connection between the receptacle 4 and the fuel pipe comprises a branch pipe 7 in which is located a check valve 8 which will permit the fuel to flow from the pipe 6 to the receptacle, but will prevent it escaping from the receptacle through the branch pipe 7. The connection between the receptacle 4 and the cylinder, or cylinders, of the engine may be accomplished in various ways, but where the engine comprises a plurality of cylinders, as in the present case, I prefer to provide a pipe 9 extending from the receptacle and connected with a manifold 10, which in turn is connected with the several cylinders of the engine. As here shown the pipe 9 extends through the top of the receptacle 4 and terminates at a point near the bottom thereof. I also prefer to provide means for controlling the communication between the receptacle 4 and the engine from a remote point, such for example as the instrument board 13 of an automobile. As here shown a valve 12, of the ordinary spring-return type, is mounted in the pipe 9 and is connected by means of a rod, or wire, 14, to the actuating device on the instrument board. The valve 12 is held normally in its closed position and the actuating device is in the form of a pull rod, slidably mounted in a frictional bearing in the instrument board and adapted to be retained in its adjusted positions by frictional contact.

In order to facilitate the starting of the engine and to prevent the accumulation of raw gasoline in the cylinders it is desirable that the fuel should be delivered to the cylinders in an atomized form and under pressure, and I have provided means in the present instance for accomplishing this result. The manifold connections with the several cylinders of the engine are shown as provided with check valves 11, which are of such a character as to permit the entrance of the fuel to the cylinders, but to prevent the escape of gas from the cylinders. To atomize the fuel as it enters the cylinders the connections between the manifold and the several cylinders are provided with small openings of such a character as to spray the fuel into the cylinders. In the present construction the casing of each check valve 11 is mounted in the cylinder head and is provided in its lower end with an opening 11^a, which is here shown as having its lower

portion in the form of a narrow transverse slot. To equally distribute fuel to the several cylinders I have formed the openings leading to the central cylinders, that is the ones connected with the manifold at points nearest the pipe 9, with openings smaller than the openings which lead to the cylinders which are further removed from the pipe 9.

In order that the fuel may be sprayed through the discharge openings to the cylinder it is preferable that it should be delivered thereto under pressure. This pressure may be secured in various ways, but in the present device I have provided means for utilizing the fuel itself as the agent for creating the pressure, and this means is of such a character that it will also heat the fuel, thus greatly facilitating the vaporization thereof. To accomplish this the fuel in the receptacle 4 is heated so as to cause the vaporization of a portion thereof, and inasmuch as the tank is of such a character that this vaporized fuel cannot escape therefrom it will accumulate within the tank above the liquid fuel and exert a pressure thereon, which, within a comparatively short time, will become sufficient to force the fuel from the receptacle into the cylinders. It is desirable that no fuel should be forced through the pipe 9 until the pressure within the receptacle has become sufficient to properly deliver fuel to the cylinders. While this may be accomplished by maintaining the valve closed for a proper length of time after heat has been applied to the fuel in the receptacle 4, I prefer to provide other means to control the flow of the fuel through the pipe 9, so that the valve 12 may be opened when the mechanism is set in operation, and but one movement required on the part of the operator, as will hereinafter appear. To this end I have mounted in the pipe 9 a spring actuated valve 16 which is in the form of a check valve held to its seat by a spring 17, the tension of which is so adjusted that it will hold the valve closed until the desired degree of pressure within the receptacle 4 has been obtained, and will open and permit the escape of the fuel when this degree of pressure is reached.

The heat for vaporizing the fuel within the receptacle 4 may be obtained from different sources, but for the sake of simplicity in construction and operation I prefer to utilize an electrical heater, and in the construction here illustrated I have shown such a heater arranged within the receptacle and partially immersed in the liquid fuel. The heater may take various forms, but that form here shown is very efficient and consists of a heating coil 18 arranged in a casing 19 formed of insulating material and metal, and provided with a longitudinal bore, or opening, 20. This casing is mounted in the

receptacle by screw-threading the enlarged upper end thereof into the top plate of the receptacle. The conductors 22 lead from the coil 18 to a source of supply for electrical current, such as a battery 23, and to a circuit breaker and closer mounted at a remote point, and in the present instance arranged on the instrument board 13. In order that the device may be set in operation by a single movement on the part of the operator I have combined the circuit breaker and closer with the valve actuating device, or pull rod, 15, this being accomplished by securing one contact member of the circuit breaker and closer, 24, to the inner end of the pull rod and arranging the same to engage the fixed contact member 25 when the pull rod is actuated to open the valve 12. It will be apparent, therefore, that when the engine is idle and the operator desires to start the same the only action necessary on his part is to operate the pull rod 15 to open the valve 12 and close the circuit through the heating coil 18. The flow of current through this coil will cause it to heat very rapidly and the vaporization of the fuel within the receptacle will begin almost instantly, and will soon create therein sufficient pressure to open the valve 16 and force the unvaporized fuel from the receptacle through the pipe 9 and the manifold 10 to the several cylinders. The unvaporized fuel having been heated within the receptacle 4 will be delivered to the cylinders in a heated condition and the pressure on the fuel will cause the same to be delivered through the openings 11^a into the receptacle and cylinders in a finely atomized form. It will be noted that the arrangement of the contacts 24 and 25 with relation to the actuating device, or pull rod, 15, is such that the contacts will be brought into engagement, and the circuit closed through the heater, only when the valve 12 is in its fully open position. This permits the valve 12 to be adjusted to deliver a supplemental supply of fuel to the engine, when the latter is in operation, without closing the circuit through the heater.

As is well known, in order to secure a proper combustible mixture for the engine under varying conditions, such as changes in temperature and the like, it is necessary to adjust the carbureter according to the conditions which may arise. The changing of a carbureter is always undesirable, particularly where the new adjustment is to be maintained for a comparatively short time only, because there is always one adjustment which is most economical and satisfactory, and the carbureter should, if possible, be always maintained in this adjustment. To enable this preferred adjustment of the carbureter to be so maintained and at the same time to secure a mixture of the desired character and quantity for the engine, I have so arranged my auxiliary feeding device that it will supply to the engine, when the latter is in operation, a heated mixture of vaporized fuel and air, the richness of which can be controlled. To accomplish this the receptacle 4 is provided with an air intake opening 26 which is controlled by a check valve 27 arranged to admit air to the receptacle, but to prevent the escape of the air or vapor therefrom. Preferably a valve 28 is provided for regulating the amount of air which can enter the receptacle. The delivery of the initial charge of fuel from the receptacle to the cylinders will leave the receptacle practically empty, and as soon as the engine starts into operation a suction will be created in the receptacle through the pipe 9. Of course fuel will begin to enter the receptacle as soon as the level therein falls below the level of the fuel in the tank 5 and the suction created in the receptacle will serve to draw this fuel into the receptacle more rapidly. Preferably the inlet is provided with a nozzle 29 by means of which the incoming fuel is sprayed against the heater, thus causing it to be vaporized. At the same time the suction within the casing is drawing air through the air inlet 26 and this air, which is then heated, is mixed with the heated vapor and this heated mixture is drawn through the pipe 9 to the cylinders, thus providing the same with a supplemental supply of heated combustible mixture. This supplemental supply of fuel may be maintained constantly if conditions require it, or it may be maintained for short intervals only, it being only necessary to operate the controlling device 15 to interrupt the operation of the auxiliary device. It will be noted that in cold weather, or under conditions in which the vaporization of the fuel in the carbureter is retarded, the auxiliary fuel device may be utilized as the sole source of supply of vaporized fuel until the carbureter has warmed up sufficiently to properly vaporize the fuel, and if the carbureter is entirely inoperative the engine can be continuously fed from the auxiliary fuel device. Means are also provided for utilizing the auxiliary fuel device to supply fuel to the engine in case the feeding mechanism, such as the vacuum feed in the present instance, should become inoperative. To accomplish this I have shown the supply pipe 6 as provided with an extension, or branch pipe, 30, which leads to the source of fuel supply, such as the gasoline tank, and have provided the pipes with a series of cut-off valves to control the flow of fuel through the same. The pipe 6 is provided with a cut-off 31 adjacent to the tank 5 and the pipe 30 is provided with a cut-off 32 between the tank and the source of fuel supply. Under ordinary operating conditions the

valve 31 is open and the valve 32 closed, thus causing the fuel to pass from the tank through the pipe 6. In the event of the vacuum feed becoming inoperative the valve 31 is closed and the valve 32 opened, thus enabling the fuel to be drawn from the source of supply through the pipes 30, 6 and 7 to the auxiliary fuel receptacle 4. The pipe 6 is also provided with a cut-off 33 arranged between the branch pipe 7, leading to the receptacle 4, and the carbureter to prevent this connection from interfering with the suction in the pipe 6. Of course the valve 33 is normally open and is closed only when it is desired to connect the auxiliary receptacle 4 directly with the fuel supply. It will be noted that if the valve 12 is maintained open after the initial priming charge has been delivered from the receptacle 4 to the cylinders that the fuel will be mixed with air in the receptacle 4 and this mixture drawn through the pipe 9 to the engine. Should the valve 12 be closed after the engine starts and the receptacle 4 again permitted to fill, the opening of the valve will cause the raw gasoline to be drawn from the receptacle 4 to the cylinders, thus enriching the mixture within the cylinders. It will also be observed that, while the check valve 27 is of such a character that it will be seated by pressure within the receptacle, the filling of the receptacle will not create sufficient pressure to seat the valve, and hence the air will be permitted to escape from the receptacle as the fuel enters the same. The closing of the valve 12 after the engine is in operation will leave the receptacle 4 with a partial vacuum which will cause the fuel to feed quickly into the same until this partial vacuum is completely destroyed, after which the fuel will feed to the receptacle by gravity and this feeding will not be fast enough to so compress the air as to cause the valve 27 to be seated, or if it should be seated, to hold it firmly in its seat. Consequently the air will work its way past the valve 27 and will not seriously interfere with the proper filling of the receptacle.

It is sometimes found desirable to feed into the cylinders of the engine a small quantity of water along with the fuel and I have provided means whereby this may be accomplished through the auxiliary fuel device. To this end I have connected the receptacle 4 with a source of water supply, which in the present instance is the water jacket of one of the engine cylinders, the connection being shown at 34. Preferably the water is led into the upper end of the cylinder in line with the heater so that as it is drawn into the receptacle by the suction therein it will be sprayed against the heater and vaporized. The steam thus mixes with the fuel and the air in the receptacle and is

drawn into the cylinders of the engine. The connection between the cylinder and the water supply pipe 34 is preferably provided with a check valve 35, such as the check valves 11 leading from the manifold 10 to the engine cylinders, which serves to admit the water to the receptacle, but will seat under pressure to prevent the escape of air, or vapor, from the receptacle. A cut-off valve 36 is also interposed in this connection to enable the amount of water fed to be regulated or to interrupt entirely the feeding of water.

I have shown the device as used in connection with a vacuum fuel feeding mechanism but it can also be applied to a gravity feed, or a pressure feed, and in Figure 5 I have illustrated the manner of applying the same to a pressure feed system, and it will be obvious that it can also be applied to a gravity feed system. As shown in this figure, the fuel tank is indicated by the reference numeral 37 and is connected with a suitable source of air pressure, such as a pump 38. The tank is connected by a pipe 39 with the carbureter 40 and the bowl of the carbureter is connected by a pipe 41 with the receptacle 4 of the auxiliary feed mechanism, this connection being the same as that heretofore described. The receptacle 4 is so arranged with relation to the carbureter that the fuel in the receptacle will be maintained at the same level with the fuel in the carbureter. The operation of the device is the same as that already described. By providing the necessary cut-offs for the pipes 39 and 41, and by interposing the valved connection 42 between the pipes 39 and 41 the auxiliary feed receptacle can be directly connected with the fuel tank 37.

It will be apparent from the foregoing description that I have invented a device which operates first as a primer for injecting an initial charge of fuel into the engine to facilitate the starting thereof, and, second, as an auxiliary carbureter to provide the engine with a supplemental supply of combustible mixture when the conditions are such as to make a supplemental supply of fuel desirable. The device can be controlled by the operator to regulate the amount of the supplemental supply of fuel which is delivered to the engine, and further, this supply may, if desired, be heated. As a primer the device will deliver to the engine a single measured charge of fuel upon one operation thereof, and is then incapable of further operation as a primer. This is due to the fact that at the end of the priming operation the pressure remaining in the receptacle 4 is insufficient to open the spring actuated discharge valve, but is sufficient to seat the check valve in the feed pipe leading to the receptacle and thus prevent fuel from entering the receptacle. Consequently

a further quantity of fuel cannot be delivered to the engine so long as this pressure is maintained, and ordinarily the pressure will be maintained until the engine has been turned over.

It will be apparent, therefore, that the construction and operation of the device is such that after the controlling device has been actuated by the operator the action of the primer is wholly automatic, both to inject into the engine the priming charge and to prevent the injection of a further quantity of fuel into the engine, and the operator cannot, either purposely or inadvertently, inject repeated charges of fuel into the engine without making an effort to start the same.

After the priming operation and after the engine has been started the device assumes the function of a supplemental carbureter. So long as the controlling valve remains fully open the operation of the engine will cause a heated mixture of fuel and air to be drawn into the cylinders. By adjusting the actuating device after the engine has become warm the heater can be cut off and the valve gradually closed to regulate the supplemental supply of combustible mixture. So long as the controlling valve is open the fuel will not accumulate in the receptacle 4 but will be vaporized therein and mixed with air. As soon as the valve is closed the liquid fuel will rise in the receptacle to the predetermined level and the device is again ready for use as a primer.

It will be apparent, therefore, that I have provided a device which will deliver to the engine, while idle, a measured charge of atomized liquid fuel; which will deliver to the engine, while in operation, and under the control of the operator, a supplemental supply of combustible mixture; and which will heat either the priming charge or the supplemental supply of combustible mixture. I believe myself to be the first to produce a device for accomplishing these functions, either individually or collectively. While I have in the present drawings illustrated the same as connected with the cylinders of the engine through a separate manifold, it will be obvious that it could be otherwise connected to the engine, as for example, through the intake manifold; and further that while the device is designed primarily as an auxiliary feed it could be utilized as a sole source of supply for fuel.

While I have shown and described one embodiment of my invention I wish it to be understood that I do not desire to be limited to the details of construction as various modifications will occur to a person skilled in the art.

Having now fully described my invention,

what I claim as new and desire to secure by Letters Patent, is:—

1. The combination with an internal combustion engine, of a device for injecting into said engine under pressure, a charge of fuel, said device comprising means independent of the operation of said engine for utilizing the fuel itself as the agent for creating the pressure and injecting the charge into the engine.

2. The combination with an internal combustion engine, of a receptacle connected with said engine and adapted to contain fuel, and means independent of the operation of said engine to vaporize a portion of the fuel within said receptacle, said receptacle being constructed to confine the vapor within the same and thus cause it to exert pressure on the unvaporized fuel and to discharge the latter from the receptacle into the engine.

3. The combination with an internal combustion engine, of a receptacle adapted to contain fuel, a conduit to connect said receptacle with said engine, a heater to vaporize a portion of the fuel within said receptacle, said receptacle being constructed to confine the vapor therein and thus cause it to exert pressure on the unvaporized fuel and discharge the same through the conduit.

4. The combination with an internal combustion engine, of a receptacle adapted to contain fuel, a conduit connecting said receptacle with said engine, a heater to vaporize a portion of the fuel within said receptacle, said receptacle being constructed to confine the vapor within the same and thus cause it to exert pressure on the unvaporized fuel and discharge the same through said conduit, and means to prevent the passage of said unvaporized fuel through said conduit until a predetermined pressure has been created within said receptacle.

5. The combination with an internal combustion engine, of a receptacle adapted to contain fuel, a conduit connecting said receptacle with said engine, a valve to control the passage of fuel through said conduit, a heater to vaporize a portion of the fuel within said receptacle, said receptacle being constructed to confine the vapor within the same and thus cause it to exert pressure on the unvaporized fuel and to discharge the same through said conduit, and a single device for actuating said valve and controlling said heater.

6. The combination with an internal combustion engine, of a receptacle adapted to contain fuel, a conduit connecting said receptacle with said engine, a valve to control the flow of fuel through said conduit, an electrical heater to vaporize a portion of the fuel within said receptacle, the receptacle being constructed to confine the vapor within the same and thus cause it to exert

pressure on the unvaporized fuel and discharge the latter through said conduit, and means to simultaneously open said valve and close the circuit through said heater.

5 7. The combination with an internal combustion engine, of a receptacle connected with said engine and with a source of fuel supply, and so arranged with relation to said source of supply as to maintain the fuel
10 therein at a constant level when said engine is idle, a heater to vaporize a portion of the fuel within said receptacle, said receptacle being constructed to confine the vapor within the same and thus cause it to exert pressure on the unvaporized fuel and discharge
15 the same from said receptacle to said engine.

8. The combination with an internal combustion engine and a carburetor therefor, of a receptacle connected with said engine
20 and with a source of fuel supply and having an air inlet, and a heater operable independently of the operation of said engine to heat the air and fuel within said receptacle whereby a heated mixture of air and fuel
25 will be delivered to the engine.

9. The combination with an internal combustion engine, of a receptacle connected with said engine and with a source of fuel supply and having an air inlet, a heater
30 arranged within said receptacle, to contact with the air and fuel therein, and an outlet communicating with said receptacle near the bottom thereof, whereby said heater will vaporize a portion of said fuel, and said
35 vapor will force unvaporized fuel through said outlet to said engine.

10. The combination with an internal combustion engine, of a receptacle connected with a source of fuel supply and having a
40 valve controlled air inlet, a conduit leading from said receptacle at a point near the bottom thereof to the cylinder of said engine, and a heater arranged within said receptacle and interposed between the fuel and air
45 inlets and said conduit.

11. The combination with an internal combustion engine, of a receptacle having a discharge pipe leading to said engine from a point near the bottom thereof and having
50 a valve controlled air inlet, and a heater mounted within said receptacle and having a longitudinal opening, and a fuel inlet having its open end arranged within said receptacle in alinement with the opening in
55 said heater.

12. The combination with an internal combustion engine, of a receptacle having a fuel supply pipe extending through the bottom of said receptacle and having a nozzle, a discharge pipe extending through the wall of said receptacle to a point near the bottom thereof and leading to said engine, an adjustable, valve controlled air inlet for
60 said receptacle, and a heater mounted within said receptacle between said air inlet and

the end of said discharge pipe and having a longitudinal opening arranged in alinement with the nozzle of said fuel supply pipe.

13. The combination with an internal
70 combustion engine comprising an intake manifold and a carburetor connected with said manifold, of means independent of said carburetor and said manifold and controlled by the operation of said engine for delivering to said engine while it is in operation
75 a supplemental supply of vaporized fuel and air.

14. The combination with an internal combustion engine comprising an intake
80 manifold and a main carburetor connected with said manifold, of a supplemental carburetor connected with said engine independently of said main carburetor and said manifold and with a source of fuel supply,
85 and adapted to be operated by said engine, and means controlling said supplemental carburetor independently of said main carburetor.

15. The combination with an internal combustion engine and a main carburetor therefor, of a supplemental carburetor connected with said engine independently of said main carburetor and with a source of fuel supply,
90 a heater for said supplemental carburetor, and means for controlling said supplemental carburetor independently of the first-mentioned carburetor and for causing the same to operate either with or without said heater.
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16. The combination with an internal
100 combustion engine and a carburetor therefor, of means for delivering to said engine while the latter is operating on said carburetor and independently of said carburetor a continuous supplemental supply of combustible mixture, and means under control of the operator to control the delivery of said supplemental supply of combustible mixture.
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17. A priming device for an internal combustion engine comprising pressure operated means for delivering to said engine, under pressure, a measured charge of fuel, and so connected with said engine that the pressure of the charge in the engine will counteract the pressure of said means and prevent the delivery of an additional charge to said engine while the first charge is in the engine.
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18. A priming device for an internal combustion engine comprising means for delivering to said engine a measured charge of fuel upon each operation of said device, and comprising a connection between said engine and said means to render the latter incapable of further operation while the charge delivered by one operation thereof remains in the engine.
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19. A priming device for an internal combustion engine comprising means for delivering to said engine a measured charge of fuel upon each operation of said device, and comprising a connection between said engine and said means to render the latter incapable of further operation while the charge delivered by one operation thereof remains in the engine.
130

ering to said engine, when the latter is idle, an initial charge of heated fuel, and for delivering to said engine, when the latter is in operation, a supplemental supply of combustible mixture, and for heating said mixture.

20. In a priming device for an internal combustion engine, a fuel receptacle, and means for vaporizing a portion of the fuel within said receptacle to create pressure therein and cause liquid fuel to be discharged therefrom to said engine.

21. In a device of the character described, a fuel receptacle having a fuel inlet and an air inlet, check valves to prevent the escape of fuel or air from said receptacle through either of said inlets, a fuel outlet, and means for vaporizing a portion of the fuel within said receptacle to create pressure and discharge liquid fuel through said fuel outlet.

22. In a device of the character described, a fuel receptacle having a fuel inlet, an air inlet, and a fuel outlet, check valves to close said inlets, a heater to vaporize a portion of the fuel within the receptacle and create pressure to discharge fuel through said outlet, a cut-off valve for said fuel outlet, and controlling means to control said valve and said heater.

23. The combination with an internal combustion engine and fuel feeding mechanism therefor, of a receptacle connected with said fuel feeding mechanism and so arranged with relation thereto that fuel will be maintained at a predetermined level in said receptacle when the engine is idle, and means for heating the fuel in said receptacle to vaporize a portion thereof, said receptacle being closed to confine vapor therein and cause unvaporized fuel to be ejected through said connection by the pressure of the vaporized fuel.

24. The combination with an internal combustion engine, and means for feeding fuel to said engine, of a receptacle connected with said engine and with said fuel feeding means and so arranged with relation to said

fuel feeding means as to cause fuel to be maintained at a predetermined level therein when said engine is idle, means for heating the fuel within said receptacle, and means for connecting said receptacle directly with a source of fuel supply.

25. The combination with an internal combustion engine, of a receptacle connected with a source of fuel supply, adapted to contain a quantity of liquid fuel, and having a valve-controlled air inlet and a water inlet, a conduit leading from said receptacle to the cylinder of said engine, and a heater arranged within said receptacle and interposed between the fuel, air and water inlets and said conduit.

26. The combination with an internal combustion engine, of a receptacle connected with a source of fuel supply adapted to contain a quantity of liquid fuel and having a valve-controlled air inlet, a conduit leading from said receptacle to the cylinder of said engine, a heater arranged within said receptacle to heat said fuel and said air, and means for injecting water into said receptacle and against said heater.

27. A device of the character described comprising a single device for delivering to an engine, when the latter is idle, an initial charge of fuel, and for delivering to said engine, when the latter is in operation, a supplemental supply of combustible mixture and means for intermingling water with said mixture before it is delivered to said engine.

28. A device of the character described comprising a single device for delivering to an engine, when the latter is idle, an initial charge of fuel, and for delivering to said engine, when the latter is in operation, a supplemental supply of combustible mixture, and means for adding water to said mixture and for heating the same before it is delivered to the engine.

In testimony whereof, I affix my signature hereto.

MELROSE G. KOPF.